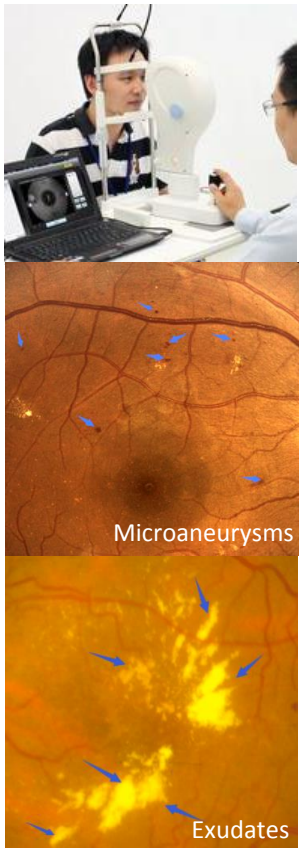
Detecting diabetic retinopathy in retinal images using deep neural networks



Diabetic Retinopathy (DR) is the main cause of blindness among the middle-aged population in the world. The progresses of diabetic retinopathy can be divided into four different stages and normally in the first stage the disease is silent, which brings difficulties to the early diagnosis of DR. The first signs of DR are: capillary microaneurysms, dot and blot hemorrhages, hard and soft exudates.

Microaneurysms (MAs) are among the early signs of DR and are small swellings which are caused by a weakening of the vessel wall and located at the side of tiny blood vessels. In digital color fundus images, MAs appear as tiny, reddish isolated dots. The MAs detection and analysis have been considered as one of the most important strategies for the early diagnosis of DR. It can significantly improve the efficiency and reduce the costs in a large-scale DR screening setting.

Another main clinical sign of the presence of DR is exudates, which appear as white/yellow structures in color fundus retinal images. The sizes of exudates have very large variations, from the similar size as MAs to even the size as large as the optic disk region.

The classical approaches for detecting MAs and exudates usually start with a preprocessing step and a subsequent candidate extraction step. Finally, a selection- or a supervised classification procedure is applied based on features from candidates to find only MAs or exudates.

Project goal

This project is mainly focused on developing an algorithm for accurate Microaneurysms detection. These quantitative measurements of MAs will be used in the design of an automatic screening system for early findings of DR. Several public datasets will be used for the evaluation (validation with the ground truth). We are also preparing two datasets for MAs detection, a color fundus retinal dataset based on the high resolution DSR camera and a SLO dataset based on the EasyScan cameras.

Student profile

- Enthusiastic students in electrical engineering, biomedical engineering, computer science, or a related field.
- Able to program in Matlab and Python.
- Knowledge of image analysis and deep learning techniques.
- A good team player with excellent communication skills.
- A creative solution-finder.

This project is part of the larger RetinaCheck project (see www.retinacheck.org).

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